

University of Pennsylvania.

---

SPECIAL ANNOUNCEMENT

OF THE

ORGANIZATION AND COURSES OF STUDY

OF THE

NEW DEPARTMENT OF SCIENCE


TO BE OPENED

September, 1872.

---

PHILADELPHIA:  
COLLINS, PRINTER, 705 JAYNE STREET.

1872.

 Any further information concerning the Department of Science may be had by addressing Professor J. P. LESLEY, Dean of the Faculty, No. 1008 Clinton Street.





UNIVERSITY OF PENNSYLVANIA

COLLEGE AND SCIENTIFIC DEPARTMENTS

# University of Pennsylvania.

---

SPECIAL ANNOUNCEMENT

OF THE

ORGANIZATION AND COURSES OF STUDY

OF THE

NEW DEPARTMENT OF SCIENCE

TO BE OPENED

September, 1872.

---

PHILADELPHIA:  
COLLINS, PRINTER, 705 JAYNE STREET,  
1872.



Digitized by the Internet Archive  
in 2018 with funding from

This project is made possible by a grant from the Institute of Museum and Library Services as administered by the Pennsylvania Department of Education through the Office of Commonwealth Libraries

## Trustees.

---

THE GOVERNOR OF PENNSYLVANIA,

EX OFFICIO, President of the Board.

REV. HENRY J. MORTON, D.D.,

RENÉ LA ROCHE, M.D.,

JOHN C. CRESSON,

FREDERICK FRALEY,

GEORGE W. NORRIS, M.D.,

ADOLPH E. BORIE,

DAVID LEWIS,

REV. CHARLES W. SCHAEFFER, D.D.,

JOHN WELSH,

PETER McCALL,

GEORGE B. WOOD, M.D., LL.D.,

ALEXANDER HENRY,

RT. REV. WILLIAM BACON STEVENS, D.D., LL.D.,

JOHN ASHHURST,

WILLIAM SELLERS,

N. B. BROWNE,

REV. RICHARD NEWTON, D.D.,

ELI K. PRICE,

J. RODMAN PAUL, M.D.,

J. VAUGHAN MERRICK,

FAIRMAN ROGERS,

HENRY C. LEA, LL.D.,

E. R. BEADLE, D.D.,

CADWALADER BIDDLE, Secretary and Treasurer.

# Faculty of the Department of Science.

---

CHARLES J. STILLÉ, LL.D., PROVOST OF THE UNIVERSITY,  
Professor of History and English Literature.

J. PETER LESLEY, A.M., DEAN OF THE FACULTY,  
Professor of Geology and Mining.

F. A. GENTH, A.M., Ph.D.,  
Professor of Analytical and Applied Chemistry and Mineralogy.

LEONARD GEORGE FRANCK, C.E.,  
Professor of Civil and Mechanical Engineering.

JOHN F. FRAZER, LL.D.,  
Professor of Natural Philosophy and Chemistry.

PERSIFOR FRAZER, JR., A.M.,  
Assistant Professor of Natural Philosophy and Chemistry.

E. OTIS KENDALL, LL.D.,  
Professor of Mathematics.

REV. ROBERT E. THOMPSON, A.M.,  
Assistant Professor of Mathematics, and Librarian.

JOHN G. R. McELROY, A.M.,  
Adjunct Professor of Greek and History.

OSWALD SEIDENSTICKER, Ph.D.,  
Professor of the German Language and Literature.

F. AMÉDÉE BRÉGY, A.M.,  
Professor of the French Language and Literature.

SAMUEL M. CLEVELAND, A.M.,  
Professor of Rhetoric and Oratory.

## INSTRUCTORS.

THOMAS W. RICHARDS,  
Instructor in Drawing.

LEWIS M. HAUPT,  
Instructor in Mathematics and Engineering.

## Announcement.

---

THE Trustees of the University of Pennsylvania, desirous fully to meet the needs of the times, have recently established a new Faculty, or Department of the University, to be known as the DEPARTMENT OF SCIENCE. Such a Department, or Scientific School, seems to be the necessary complement at the present day of a system of instruction maintained by an establishment called a University, in such a city as Philadelphia. In this city the daily product of the manufacturing industry alone of the population now reaches more than a million of dollars in value, and the continued prosperity of that industry must depend, in a great measure, upon a general diffusion of the technical skill and knowledge which it is the main object of the new Scientific School to impart. The Trustees have heretofore established different departments of instruction in the University as the exigencies of the times seemed to demand them. The Department of Arts was established in 1755; that of Medicine in 1765; that of Law in 1789; that of the Auxiliary Faculty of Medicine in 1864. The Trustees, while maintaining the other departments in increased vigor and efficiency, would be blind to the significance of the facts around them did they hesitate now to add one specially devoted to instruction in the applications of Science to the industrial arts.

### Organization and Objects of the Department of Science.

The government and instruction of the students in this Department will be in the charge of a distinct Faculty, under the general supervision of the Provost and Board of Trustees.

The design of the instruction is to give a thorough technical and professional training to those who propose engaging in the following among other pursuits, viz.: in CHEMISTRY, with its manifold applications to the industrial arts; in MINERALOGY, GEOLOGY, and MINING; in METALLURGY and ASSAYING; in ENGINEERING, CIVIL, MECHANICAL, and MINING, and in MECHANICAL DRAWING and ARCHITECTURE.

In order that this professional course shall be complete and systematic, and rest upon a broad basis, so that the student at its close may not be a mere *specialist*, but a man of liberal education as well, it has been determined that the course shall be a comprehensive one, extending through four years. The first two years will be devoted, not merely to a thorough training in the preparatory and elementary Mathematics, Physics, Chemistry, and methods of physical research generally, but a considerable portion of the time will be given to instruction in certain English studies—History, Logic, Rhetoric, and Oratory—as well as to the Modern Languages and to Mechanical Drawing.

At the close of these two years the student is presumed to be prepared for studies of a strictly professional or technical character, and he will then select one of four parallel courses, in which instruction is given in this Department, and during the last two years his work will be confined to the studies of one or other of these courses in accordance with the plans he may have formed in regard to his future profession.

The professional courses, from which a student may select, are at present—

- I. COURSE IN ANALYTICAL AND APPLIED CHEMISTRY AND MINERALOGY.
- II. COURSE IN GEOLOGY AND MINING.
- III. COURSE IN CIVIL ENGINEERING.
- IV. COURSE IN MECHANICAL ENGINEERING.

The Degree conferred by the University on the satisfactory completion of any one of these professional courses is that of BACHELOR OF SCIENCE. Rules for conferring other Degrees usual in Scientific Schools will be established hereafter.

## Buildings, Apparatus, etc.

The Trustees have erected, on the square bounded by Locust, Spruce, Thirty-fourth, and Thirty-sixth Streets, a building of imposing architectural appearance and of most extensive and convenient arrangements, which will be ready for the reception of students in September, 1872. This building is two hundred and sixty feet front, by over one hundred feet in depth. One portion of it is appropriated to the Department of Arts (the Collegiate Department proper), and certain other portions (such as the Chapel, Library, the Assembly-Room, etc.) are intended for the common use of both Departments; but it will be seen by reference to the plans accompanying this Announceement, that the special arrangements made for technical instruction in the Department of Science are at least equal in extent to those to be found in any similar establishment in this country.

In the basement story there are two preparing Chemical Laboratories, and two Physical Laboratories, a Metallurgical Laboratory, a Fire-proof Furnace-room, Rooms for Gold and Silver Assaying, and an Apparatus and Diagram Room.

In the first, second, and third stories are the Chemical and Physical Lecture and Apparatus Rooms; Laboratories for Qualitative, Quantitative, and Organic Analysis; Professors' Private Laboratory and Balance Rooms; and also large Recitation, Lecture, and Model Rooms in the Departments of Civil and Mechanical Engineering, Mining, Mineralogy, Metallurgy, Architecture, and Drawing.

It must be evident, from this abundant provision of rooms, that it is the intention of the Trustees to organize their Scientific School upon the most liberal and comprehensive plan. To carry out fully their design, Museums, Cabinets, and a large amount of Apparatus are required. A considerable portion of the most modern and approved appliances of instruction in all the Departments has been already secured, and additions will be made as experience suggests new wants. The University has recently received, from the family of the late Dr. CHARLES M. WETHERILL, a gift of his extensive and

valuable Chemical Library, and another of its friends has appropriated a large sum for the purchase of a complete collection of works relating to the subject of Engineering in all its branches. A large number of American and foreign scientific periodicals will be accessible to the students in the Reading-Room.

In addition to these collections, the Library of the University has been recently increased by the gift of the late STEPHEN COLWELL, Esq., of his unique and valuable library of books in various languages, numbering nearly six thousand volumes relating specially to the Department of Social Science.

### Terms of Admission, &c.

Candidates for admission to the course in the Department of Science must be at least sixteen years of age, and must be prepared to pass an examination in Ancient and Modern Geography, in English Grammar, in Arithmetic, and in Algebra as far as Quadratic Equations.

The college year is divided into three terms: the *first* beginning on the 15th of September, and ending on the 24th of December; the *second* beginning on the 2d of January, and ending on the Wednesday before Easter, and the *third* beginning on the Tuesday after Easter, and ending on the last Thursday of June (Commencement day).

Candidates should present themselves for examination for admission at the University building in Ninth Street, below Market, on WEDNESDAY, JUNE 26, 1872, at 10 A.M.; or at the New Building, Locust and Thirty-Sixth Streets, on MONDAY, SEPTEMBER 16, 1872, at the same hour.

No student can be admitted to an advanced standing without showing on examination that he is as fully instructed as the class to which he asks admission has been.

The fees for instruction in this Department are \$50 per term (payable in advance), or \$150 per annum.

A separate charge is made for chemicals and the use of apparatus.

Special students (not candidates for a degree) may be received in any of the professional courses, when, in the opinion of the Professor, the applicant is prepared to derive profit from the instruction given. To these students a CERTIFICATE OF PROFICIENCY will be awarded upon the completion of such a course and a satisfactory examination therein.

Any further information concerning the Department of Science may be obtained by addressing Professor J. P. LESLEY, Dean of the Faculty, 1008 Clinton Street.

### Courses and Methods of Instruction.

The students in the Scientific Department will be divided into four classes, SENIOR, JUNIOR, SOPHOMORE, and FRESHMAN.

Instruction will be given by lectures and recitations, by field practice, and by daily exercises in the Laboratories and the Drawing-rooms.

The Laboratories will be open for instruction during the whole day, and the students will be required to work in them, as well as in the Drawing-rooms, during the afternoons of five days in the week, as well as in the hours named in the Roster.

Field practice in Surveying and Engineering, Excursions for the study of Geology and Mining practically, and visits to Machine-shops and Manufactories, will form an essential part of the instruction.

The following is an outline of the course of study to be pursued in this department.

#### FRESHMAN YEAR.

MATHEMATICS.—Algebra. Mensuration (*Vogdes*). Geometry. Descriptive Geometry.

ENGLISH.—Weber's Outlines of Universal History, with Labberton's Historical Atlas. Compositions and Declamations.

PHYSICAL SCIENCE.—Somatology. Elementary Chemistry. Elements of Geology.

FRENCH.—*Collot's* Pronouncing French Reader. *Bregy's* Compendium of Grammatical Rules. (First Part.) Guide to French Conversation (*Smith*).

DRAWING.—Geometrical and Isometrical Drawing, and Drawing from the Flat. Free Hand Sketching.

#### SOPHOMORE YEAR.

MATHEMATICS.—Trigonometry, Plane and Spherical (*Legendre*), with Applications to Surveying, &c. Descriptive Geometry. Conic Sections. Analytical Geometry. Differential Calculus.

PHYSICAL SCIENCE.—Theoretical Mineralogy. Theoretical Inorganic and Organic Chemistry. Topographical Geology.

ENGLISH.—Elements of Rhetoric (*Buin's Rhetoric*), with Lectures and Practical Exercises. Logic. Lectures on the English Language. *Gibbon's* Decline and Fall of the Roman Empire. Compositions and Declamations.

GERMAN.—*Plate's* German Studies. Practical Exercises in Translation.

FRENCH.—“*Un Philosophe sous les toits.*” *Sue's* Grammar. Guide to French Conversation (*Smith*).

SPANISH.—*Ollendorf's* Spanish Method. *Tolon's* Spanish Reader.

DRAWING.—Perspective drawing. Principles of Architecture. Shading in Indian Ink. Ornamental Drawing.

These studies will be taken in common by all the students in the Department of Science. When completed, at the close of two years, each person will select (as before stated), from the four parallel courses in which instruction is given in this Department, one, viz.: either, I. ANALYTICAL AND APPLIED CHEMISTRY AND MINERALOGY; or, II. GEOLOGY AND MINING; or, III. CIVIL ENGINEERING; or, IV. MECHANICAL ENGINEERING; and devote himself during the last two years to the studies enumerated below, as specially adapted to the course which he has selected.

Instruction will also be given to all the students of the Scientific Course during the last two years in English Composition and Literature, in German, in Physics, in Modern History, in Social Science, and in International and Constitutional Law.

In order more fully to explain the full course of professional training adopted in this Department, a statement in detail of the studies to be pursued in each course during the entire period of four years is appended, as follows:—

## I. COURSE OF ANALYTICAL AND APPLIED CHEMISTRY AND MINERALOGY.

It is designed that the course of instruction in Chemistry shall consist of the two years of theoretical training in the Freshman and Sophomore classes which is required of all the students in the Department of Science, and of two years of practical work in the Laboratories of that Department.

The course embraced in these four years is as follows:—

### Freshman Year.

FIRST TERM.—General definitions of scientific terms: Somatology or experimental illustrations of the general properties of bodies.

Relations of states of matter to physical forces and sources and effects of some of the latter.

French metrical system.

SECOND TERM.—Experimental illustrations of chemical phenomena and definition of chemical terms.

Experimental demonstration of the fundamental facts on which chemical science is based. Conclusions drawn from class experiments. Symbolic formulæ.

Chemical formulæ and equations.

THIRD TERM.—Atomic and molecular theories.

The old chemical system and nomenclature.

Quantivalence.

Empirical and rational formulæ, and the conversion of the one into the other.

REVIEW.

Oral or written examination.

### Sophomore Year.

FIRST TERM.—Chemistry of the non-metals and their combinations with each other.

Equations of decomposition and combination and stoichiometric calculations.

Crystallography. The morphological properties of minerals and artificial salts. The use of the goniometer.

SECOND TERM.—Chemistry of the metals and their compounds. Practice in stoichiometric calculations.

Organic compounds and families.

Theoretical Mineralogy. The general physical properties of minerals and their classification.

THIRD TERM.—Organic compounds.

Examination of the morphological and physical properties of natural and artificial salts prepared by scientific students.

REVIEW.

Oral or written examination.

## Junior Year.

FIRST TERM.—Practical instruction in Chemical Manipulation, the use and construction of apparatus, and the detection of the more frequently occurring elements and the simpler compounds: including the use of the blowpipe and the employment of flame reactions.

Instruction in the practical production of chemical salts, preparations and simple substances in their greatest perfection and purity; and also according to the principles which govern their manufacture on a large scale. It is intended by these means not only to furnish the students with valuable experience in chemical manufacture while providing the University with a cabinet of artificial salts of the greatest purity, but also to obtain full sets of salts in their most perfect condition, and a cabinet of crystals, the morphological properties of which are to be studied by the students. This practice in the production of chemical preparations and in the determination of their forms and those of minerals, will be continued until the graduation of the student.

SECOND TERM.—Qualitative Analysis of more complex substances with practice in determining the color and condition of products.

Examinations by questions to teach habits of correct chemical reasoning.

Continuation of practice in making chemical preparations.

Lectures and practice in the determination of minerals.

THIRD TERM.—Qualitative Analysis and detection of the more rare elements and organic constituents of bodies.

Introduction to quantitative analysis.

Use of the spectroscope in qualitative determinations.

Lectures and practice in determination of minerals.

## Senior Year.

**FIRST TERM.**—Quantitative Gravimetric Analysis of the simple salts and minerals. Practice in the analysis of unknown bodies and discussion with reference to the selection of the best method of determining each constituent.

Volumetric Analysis and preparation of normal solutions.

Gas analysis. Manufacture, graduation, and use of eudiometers. Photometric tests.

Practice in the production of chemical preparations.

**SECOND TERM.**—Quantitative Gravimetric Analysis of Salts and Minerals of complex constitution. Determination of the constituents of cast-iron and steel—practice in Agricultural Chemistry, and Analysis of Manures.

Volumetric Analysis.

Dry assaying and metallurgical practice.

Organic Analysis.

**THIRD TERM.**—Quantitative Analysis of complex bodies. Determination of small amounts of impurities (adulteration and poisons in food and drink).

Analysis of water of mineral springs.

Organic Analysis.

Dry assaying and metallurgical practice.

Practice in production of Chemical preparations.

## II. COURSE OF GEOLOGY AND MINING ENGINEERING.

The instruction in Geology will comprise two years' instruction in the Freshman and Sophomore Classes common to all the Scientific Students, and two years of more technical work to such as elect this course.

### Freshman Year.

**FIRST TERM.** *Definitions.*—The Nomenclature of the Science. The Nomenclature of Formations.

**SECOND TERM.** *Definitions.*—The Nomenclature of Fossils.

**THIRD TERM.** *Definitions.*—The Nomenclature of Field and Office Work.

All the above to be illustrated by use of diagrams, models, hand specimens, and instruments.

## Sophomore Year.

FIRST TERM.—Topography applied to Geology. Erosion.

Rough sketching in the field. Contours.

Limits of accuracy. Law of compensation.

Labor-saving methods of observation.

Checking work by varying the method.

SECOND TERM.—Mapping topographical field-notes.

Various styles of maps. Contours.

Coloring of geological maps.

Vertical sections on a true scale.

THIRD TERM.—Underground topography. Mine surveys.

Underground plans and elevations.

Calculations of place and quantity.

Reports on properties.

## Junior Year.

FIRST TERM (AND CONTINUED THROUGH THE YEAR).—Special Geology of the United States taken up in order of the Formations, with characteristic minerals and fossils.

Laurentian, Huronian, Palæozoic, Mesozoic, Neozoic, Actual Systems.

Field practice.

SECOND TERM.—The Physical features of the Surface of the United States, indicative of, and explained by, the Geology.

Physical features of the surface in different geological ages.

History of the Theory of Erosion. The Glacial Hypothesis.

Metamorphism.

THIRD TERM.—The general Geology and Topography of the World, with regard also to the distribution of the metals and fuels.

Field practice.

## Senior Year.

FIRST TERM.—The Coal Mines of the United States.

Methods of mining. Statistics. Uses. Markets, &c.

History of coal mining in Europe and Asia.

Field practice.

SECOND TERM.—The Iron Mines of the United States. Methods of mining.

Relation of the mines to the iron manufacturing centres, &c.

History of iron mining in the world.

[The machinery, shutes, breakers, &c. of outside work will be given in connection with the methods of mining.]

THIRD TERM.—The Copper, Lead, Silver, Gold, Salt, &c., Mines of the United States.

Petroleum wells.

Field practice.

In each term, Lectures on Lithology, and Practice in the determination of rocks.

### III. CIVIL AND MECHANICAL ENGINEERING.

#### Freshman Year.

Mathematics.—*Algebra. Geometry.*

*Descriptive Geometry.*—Problems, including the Point, Right Line, and Plane.

*Drawing.*—Use of the Scale and Protractor. Water-colors. Graphical representations from Geometry. Free Hand Sketching. Ornamentation.

#### Sophomore Year.

*Plane and Spherical Trigonometry: Analytic Geometry.*—Point, Line, and Intersection of Planes.

*Differential Calculus.*—Introduction. Differentials of Logarithms and Circular Functions.

*Surveying.*—Plotting from Field-notes. Computing of Areas. Field Practice.

*Descriptive Geometry.*—Practical Problems. Shades, Shadows, and Perspective.

*Drawing.*—Isometric and Linear Perspective. Graphical representations from Descriptive Geometry. Ornamental Drawing. Landscape.

#### Junior Year.

##### COURSE IN MECHANICAL ENGINEERING.

*Differential and Integral Calculus* completed.

*Analytic Geometry.*—Conic Sections completed.

*Applied Mechanics.*—Laws of Motion. Statics and Dynamics of Rigid Bodies.

*Machinery.*—Definition of Elementary Machines. Work done by Machines. Apparatus to Measure the Mechanical Effect. Regulating Apparatus: Fly-wheel. Governors and Brakes. Friction.

*Descriptive Geometry.*—Applications to the Projections of Machines.

*Drawing.*—Parts of Machines: Wheel-work. Curvature of Teeth of Wheels. Cylinders. Valves. Connecting-rods. Stub-ends, &c.

## Junior Year.

### COURSE IN CIVIL ENGINEERING.

*Differential Calculus.*—Completed.

*Applied Mechanics.*—Motion of a Material Point. Statics and Dynamics of Rigid Bodies.

*Descriptive Geometry.*—Application to Ground Plans. Elevations and Sections.

*Geodesy.*—Latitude and Longitude.

*Engineering.*—Masonry. Framing. Classification of Roofs and Bridges.

*Drawing.*—Topographical Drawing. Roofs. Bridges.

## Senior Year.

### COURSE IN MECHANICAL ENGINEERING.

*Applied Mechanics.*—Statics and Dynamics of Fluid Bodies.

*Machinery.*—Strength and Proportions of Machines. Water-wheels. Water-pressure Engines. Steam and its properties. Steam-engines. Air and Gas Engines. Estimates and Contracts.

*Drawing.*—Construction of Machines. Working Drawings.

## Senior Year.

### COURSE IN CIVIL ENGINEERING.

*Engineering.*—Calculation of the Strength of Roofs and Bridges. Foundations. Retaining Walls. Arches. Rectification of Rivers. Roads and Canals. Field Practice. Estimates and Contracts.

*Machinery.*—Hand-machinery. Water-wheels. Steam-engines.

*Geodesy.*—Triangulation. Geodetic Surveying.

*Drawing.*—Plans. Elevations. Sections.

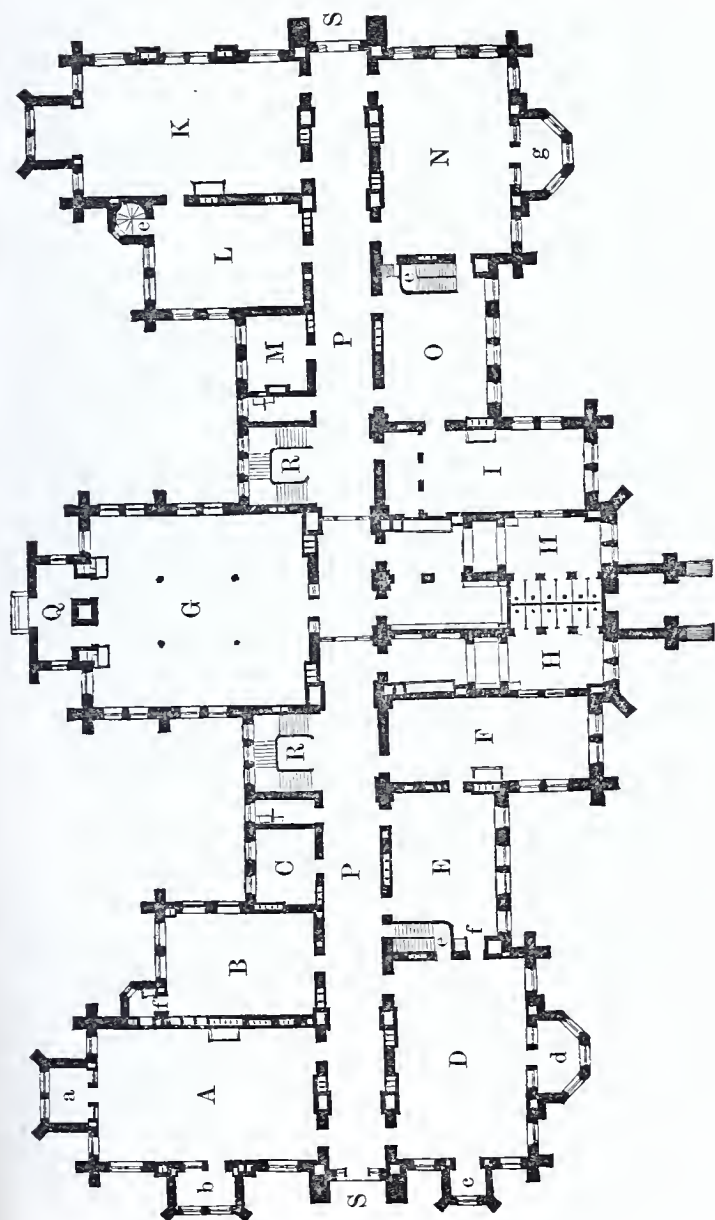
Besides these special courses, all the students of the Scientific Department will receive instruction together—

### IN THE JUNIOR YEAR.

In Theoretical Mechanics, Heat, Sound, and Light; in the German Language and Literature, and in English Literature, Composition, History, Social Science, &c.

### IN THE SENIOR YEAR.

In Electricity, Astronomy, and Physical Geography, and in advanced English and German studies.



PLAN OF BASEMENT.

- A. Metallurgical Laboratory.
- B. Furnace Room.
- C. Balance Room.
- D. Machinery and Work Room.
- E. Store and Apparatus Room.
- F. Janitor.
- G. Assembly Room.
- H. Water Closets.
- I. Store Room.

- K. Physical Laboratory.
- L. Store Room—Department of Physics.
- M. Janitor.
- N. Preparing Laboratory—Chemistry
- O. Store Room—Department of do.
- P. Corridor.
- R. Main Stairway.
- a, b, c, d, e, g. Assistants' Rooms.

